

Appln No. 10/629,505

Amdt date June 6, 2005

Reply to Office action of March 4, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1. (Currently Amended) A method for optically coupling optical components, comprising:

providing a base substrate;

providing a plurality of optical components including a light source and an adjustable optical element;

forming an optical subassembly by placing passively aligning said plurality of optical components in using a jig stencil positioned over said base substrate, thereby passively aligning said plurality of optical components laterally with respect to one another, and joining, in fixed positions, said plurality of optical components to said base substrate;

passively aligning said optical subassembly to an optical transmission medium; and

adjusting said adjustable optical element of said optical subassembly such that optical power of light emitted by said light source and directed into said optical transmission medium, is maximized.

Claim 2. (Currently Amended) The method as in claim 1, in which said jig ~~includes a jig stencil having a corresponding is~~ generally planar and has a plurality of openings therethrough; and

said passively aligning placing said plurality of optical components in said jig stencil includes positioning said

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plurality of optical components within said corresponding plurality of openings.

Claim 3. (Original) The method as in claim 1, in which said adjustable optical element comprises a microelectromechanical structure (MEMS) and said adjusting includes causing said light source to emit light and mechanically adjusting said MEMS.

Claim 4. (Original) The method as in claim 3, in which said MEMS includes a mirror and said adjusting includes adjusting a position of said mirror

Claim 5. (Original) The method as in claim 1, in which said passively aligning includes positioning said optical components to satisfy an alignment tolerance of one of about +/- 10 microns and about +/-5 microns.

Claim 6. (Original) The method as in claim 5, in which said joining includes forming a solder layer between each of said plurality of optical components and said base substrate, and heating to join said optical components to said base substrate such that said plurality of optical elements continues to satisfy said alignment tolerance.

Claim 7. (Original) The method as in claim 1, in which said passively aligning said optical subassembly to an optical transmission medium, includes the use of at least one mechanical guide.

Claims 8-12. (Cancelled).

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Claim 13. (Currently Amended) The method as in claim [[12]]2, in which said positioning includes positioning at least one of said optical components within a corresponding one of said openings and contacting a retractable portion that forms part of a border of said corresponding opening, said retractable portion resiliently urging said at least one of said optical components into alignment position.

Claim 14. (Currently Amended) ~~The~~ A method for optically coupling optical components, comprising: as in claim 13,

providing a base substrate;

providing a plurality of optical components including a light source;

providing a jig;

aligning said plurality of optical components using said jig such that said light source is optically aligned to further of said optical components;

forming a solder layer between each of said plurality of optical components and said base substrate;

joining said optical components to said base substrate such that said light source remains optically aligned to said further of said optical components;

in which said jig includes a corresponding plurality of openings therethrough, said providing includes positioning said jig over said base substrate, and said aligning includes positioning said plurality of optical components within said corresponding plurality of openings;

in which said positioning includes positioning at least one of said optical components within a corresponding one of said openings and contacting a retractable portion that forms part of a border of said corresponding opening, said retractable portion

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resiliently urging said at least one of said optical components into alignment position; and

in which said joining comprises heating and further comprising cooling after said heating, and in which said jig has a thermal coefficient of expansion different from a thermal coefficient of expansion of said base substrate and said retractable portion retracts to allow said jig to move relative to said optical components, during said cooling.

Claim 15. (Original) The method as in claim 13, in which said positioning includes retracting said retractable portion from said opening then inserting said at least one of said optical components within said corresponding opening.

Claim 16. (Currently Amended) ~~The~~ A method of optically coupling optical components, comprising: as in claim 8,

providing a base substrate;

providing a plurality of optical components including a light source;

providing a jig;

aligning said plurality of optical components using said jig such that said light source is optically aligned to further of said optical components;

forming a solder layer between each of said plurality of optical components and said base substrate;

joining said optical components to said base substrate such that said light source remains optically aligned to said further of said optical components; and

in which said joining comprises heating to join said optical components to said base substrate and further comprising subsequently cooling, and said jig moves relative to said optical components thereby preventing said joined optical

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components from moving with respect to said base substrate, during said step of cooling.

Claim 17. (Currently Amended) ~~The~~ A method of optically coupling optical components, comprising: as in claim 8,

providing a base substrate;

providing a plurality of optical components including a light source;

providing a jig;

aligning said plurality of optical components using said jig such that said light source is optically aligned to further of said optical components;

forming a solder layer between each of said plurality of optical components and said base substrate;

joining said optical components to said base substrate such that said light source remains optically aligned to said further of said optical components; and

further comprising providing a jig clamp having a base section coupled to a movable cover, and in which said providing a base substrate comprises positioning said base substrate on said base section, and further comprising positioning said cover over said plurality of optical components to urge said plurality of optical components toward said base substrate.

Claim 18. (Original) The method as in claim 17, in which said cover includes at least one protuberance and said positioning said cover includes resiliently urging said plurality of optical components toward said base substrate.

Claim 19. (Original) The method as in claim 17, wherein said base section includes a protuberance and said jig includes an alignment opening bounded by at least one retractable surface

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and said positioning includes said alignment opening receiving said protuberance therein.

Claim 20. (Currently Amended) The method as in claim [[8]]18, in which said joining includes soldering said optical components to said base substrate substantially simultaneously.

Claims 21-25. (Cancelled)

Claim 26. (Currently Amended) The apparatus as in claim [[24]]1, in which at least one of said openings is bounded in part by a fixed reference surface that positions an associated one of said plurality of said optical components within said opening, and is movable with respect to said plurality of optical components that are fixed with respect to each other, during thermal processing.

Claim 27. (Currently Amended) ~~The~~ An apparatus comprising:
~~as in claim 24,~~

a jig stencil having a plurality of openings that receive a corresponding plurality of optical components therein and passively optically align said plurality of optical components to one another, at least one of said openings bounded by a retractable portion which contacts an associated one of said plurality of said optical components received in said opening;
and

further comprising a jig clamp for securing said plurality of optical components disposed within said openings, to a base substrate, said jig clamp including a base and cover.

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Claim 28. (Original) The apparatus as in claim 27, in which said base receives said base substrate thereon and said cover is movably coupled to said base.

Claim 29. (Original) The apparatus as in claim 27, in which said cover includes mechanical protuberances that resiliently urge at least one of said optical components toward said base substrate.

Claim 30. (Original) The apparatus as in claim 27, wherein said jig stencil further includes an alignment feature that aligns said jig stencil to said base.

Claim 31. (Original) The apparatus as in claim 30, wherein said base includes a protuberance and said alignment feature comprises a peripheral opening bounded at least partially by a retractable surface, said jig stencil aligned to said base when said protuberance is received within said opening.

Claims 32-37. (Cancelled)

Claim 38. (Currently Amended) ~~The~~ An apparatus comprising:
~~as in claim 37,~~

an alignment jig,

an optical subassembly comprising a plurality of optical components including a light source, and

an optical transmission medium,

said optical subassembly and said plurality of optical components arranged such that light emitted by said optical source is directed to said optical transmission medium by further of said plurality of optical elements, and said optical

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subassembly includes alignment tolerances obtainable with said alignment jig;

in which said alignment jig includes a jig stencil including a plurality of openings for receiving said optical components, at least one of said openings bounded in part by a retractable portion; and

in which said jig stencil and said base substrate include different coefficients of thermal expansion and said retractable surface portion substantially precludes said optical components from moving with respect to said base substrate when said base substrate and said optical components are heated then cooled.

Claims 39-46. (Cancelled).

Claim 47. (New) A method of optically coupling optical components, comprising:

providing a base substrate;

providing a plurality of optical components including a light source;

providing a jig;

aligning said plurality of optical components using said jig such that said light source is optically aligned to further of said optical components;

forming a solder layer between each of said plurality of optical components and said base substrate;

joining said optical components to said base substrate such that said light source remains optically aligned to said further of said optical components; and

wherein said joining comprises heating said solder layer along with said base, said optical components, and said jig and subsequently cooling said solder layer along with said base, said optical components, and said jig, and said jig moves

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relative to said optical components thereby preventing said joined optical components from binding to the jig during said cooling.

Claim 48. (New) A method for optically coupling optical components, comprising:

providing a base substrate;

providing a plurality of optical components including a light source and an adjustable optical element;

forming an optical subassembly by passively aligning said plurality of optical components using a jig and joining said plurality of optical components to said base substrate;

passively aligning said optical subassembly to an optical transmission medium; and

adjusting said adjustable optical element such that optical power of light emitted by said light source and directed into said optical transmission medium is maximized, thereby accounting for imperfections in the passive alignment of said optical subassembly to said optical transmission medium.

Claim 49. (New) The apparatus as in claim 48, wherein said jig is fabricated using electron discharge machining.

Claim 50. (New) A method forming an optical subassembly optically coupled to an optical fiber, comprising:

placing a metal jig stencil over a base substrate, the metal jig stencil and the base substrate having different coefficients of thermal expansion, the jig stencil having a plurality of holes therethrough, with each hole of the plurality of holes having an optical component therein, with at least one of the holes having a laser therein and at least one other of the holes having an adjustable mirror therein;

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joining the optical components to the base substrate in fixed positions to form an optical subassembly;

passively aligning the optical subassembly to an optical fiber; and

adjusting the adjustable mirror to maximize the amount of light emitted from the laser reaching the optical fiber.

Claim 51. (New) The method of claim 50 wherein joining the optical components to the base substrate comprises heating a solder layer on the base substrate and cooling the solder layer on the base substrate.

Claim 52. (New) The method of claim 51 further comprising clamping the base substrate and optical components to urge the optical components towards the base substrate.